Seasonal Variation in the Prevalence of Common Orthopaedic Upper Extremity Conditions

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Abstract

Introduction Seasonal variation in disease processes and injuries have been reported, but it is unclear if this variation exists in upper extremity disorders. The goal of this study is to characterize seasonal and weather variations in common upper extremity orthopaedic conditions.

Methods This cross-sectional study reviewed 68,943 consecutive, new patient visits from January 2010 to September 2015 for carpal tunnel syndrome (CTS), trigger finger (TF), DeQuervain's tenosynovitis (DeQ), lateral epicondylitis (LE), hand arthritis (OA), and distal radius fractures (DRF). Presentation rates for each condition were compared across month, season, and various weather parameters.

Results DRF, OA, and LE had a higher rate of presentation in the winter compared with all other seasons ($p < 0.001$). TF and DeQ showed no statistically significant seasonal differences. Higher barometric pressures were associated with higher rates of all of the diagnoses. Higher humidity was associated with lower rates of CTS, TF, DeQ, LE, and DRF ($p < 0.001$). There was no significant association between temperature levels or amount of precipitation.

Discussion Although the precise mechanism remains unclear, there does appear to be an impact of winter, increased barometric pressure, and higher humidity on presentation rates. Further studies are needed to determine more conclusively why this occurs.

Level of Evidence Level IV, cross-sectional study.

Keywords
- distal radius fracture
- carpal tunnel syndrome
- trigger finger
- Dequervain's tenosynovitis
- lateral epicondylitis
- arthritis
- seasonal variation

Seasonal variation in common disease processes and injuries are well reported in the literature. The incidence of and mortality from stroke, sepsis, and cardiac arrest is consistently highest during the winter months.[1–3] The same has been found for gastrointestinal diseases such as appendicitis, cholecystitis, and diverticulitis[4–8] and the summer months. There has also been seasonal variation reported in metabolic diseases such as diabetes.[9] Similarly, with regard to traumatic conditions, increased temperatures and a stepwise increase in the amount of precipitation have been found to correlate with an increase in trauma center visits for both orthopaedic and nonorthopaedic causes.[10] Whether any seasonal or weather variation exists in common upper extremity musculoskeletal conditions is not well established. The goal of this study is to characterize

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seasonal and weather variation in common upper extremity orthopaedic conditions. Our hypothesis is that both seasonal and weather variation exists among these disorders.

Methods

Institutional Review Board approval was obtained for this study. In this cross-sectional study, we created a roster of new patients who presented to our practice for treatment of common orthopaedic upper extremity conditions by searching the computerized billing records of our academic orthopaedic surgery practice. We searched our database for the following conditions using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes: carpal tunnel syndrome (CTS, 354.0); trigger finger (TF, 727.03); DeQuervain's tenosynovitis (DeQ, 727.04); lateral epicondylitis (LE, 726.32); hand arthritis (OA, 715.94, 715.84, 715.34, 715.24, and 715.14); and distal radius fractures (DRF, 813.4, 813.41–.47, and 813.5, 813.51–.52).

Patient age, gender, and date of presentation for treatment for each of the six diagnoses were tabulated. Seasons were defined as winter (December–February), spring (March–May), summer (June–August), and fall (September–November). We reviewed 68,943 new patient, consecutive visits from January 2010 to September 2015. The number of patients who presented for treatment for each diagnosis was calculated as a proportion of the total number of visits for that season to normalize for seasonal differences in patient visits. Temperature,[11] precipitation,[11] barometric pressure readings,[11] and humidity[12] were obtained from the National Oceanic and Atmospheric Association as well as TimeAndDate.com (Philadelphia, PA). Presentation rates were compared with these variables for each month and season to determine if a correlation was present.

Proportions of diagnoses were compared across months or across seasons within each diagnosis, using Holm–Bonferroni adjustment for multiple pairwise tests within each diagnosis. Across months, associations between weather parameters and diagnosis rates were determined using Spearman's rho.

Results

Patients with DRF had a statistically significant higher rate of presentation in the winter months (10.4%) compared with the rest of the seasons (spring 8.3%; summer 8.4%; and fall 8.6%, $p < 0.001$). Patients with CTS presented at higher rates in the winter and spring (13.9 and 13.6%, respectively) compared with the summer and fall (11.9 and 11.4%, respectively). These differences were statistically significant ($p < 0.001$). Patients with OA had a statistically significant higher rate of presentation in the winter (8.24%) compared with the summer (6.68%, $p < 0.001$) and fall (7.5%, $p = 0.04$). Patients with LE had a significantly higher rate of presentation in the winter (12.1%) compared with the summer (10.5%, $p < 0.0001$) and fall (10.6%, $p < 0.001$). TF and DeQ showed no statistically significant seasonal differences.

Higher average barometric pressures were associated with higher rates of all of the diagnoses evaluated: CTS ($r_s = 0.042$, $p < 0.001$), TF ($r_s = 0.31$, $p = 0.01$), DeQ ($r_s = 0.029$, $p = 0.01$), OA ($r_s = 0.48$, $p < 0.001$), LE ($r_s = 0.42$, $p < 0.001$), and DRF ($r_s = 0.43$, $p < 0.001$). Higher humidity levels were associated with significantly lower rates of CTS ($r_s = -0.24$, $p < 0.05$), TF ($r_s = -0.40$, $p < 0.001$), DeQ ($r_s = -0.44$, $p < 0.001$), LE ($r_s = -0.26$, $p = 0.03$), and DRF ($r_s = -0.31$, $p = 0.009$). Lower rates of OA were associated with higher humidity ($r_s = -0.18$); however, this was not statistically significant ($p = 0.14$). There was no significant association between temperature or amount of precipitation and rates for any the above diagnoses (►**Figs. 1** and **2**).

Discussion

Seasonal variation in medical diagnoses has been described in the literature, with examples spanning across several different specialties. We have found this to be consistent with upper extremity conditions as DRF, OA, CTS, and LE all had statistically significant increases in presentation rates during the winter months. Ilves et al found a significant association between temperature and the incidence of acute appendicitis, with the incidence of acute appendicitis being significantly decreased during the cold months of the year.[8] Zangbar et al report significant seasonal variation in acute cholecystitis admissions with the highest hospital rate during the summer months and the lowest during the winter months.[4]

The reason for cyclic changes in the presentation of these conditions, while still not entirely understood, has been attributed to a variety of causes. Seasonal variation in certain viral infections correlates with the incidence of appendicitis and diabetes,[13–15] whereas in the development of diverticulitis, higher levels of vitamin D are thought to be protective. Less time spent outdoors during the winter months may contribute to this phenomenon.[16]

Similar to our findings, Scalco et al described seasonal variation in the prevalence of CTS in 1,039 patients. They found a statistically significant increase in the winter months.[17] Similarly, Saeed and Irshad reported an association between CTS and winter months in 213 patients.[18] A possible explanation for this finding could be that the immediate nerve entrapment symptoms become worse in periods of colder weather, and consequently may be more noticeable in the winter. It is not known whether the increase in symptomatic CTS is because of changes in nerve conduction parameters, environmental effect, or some mechanism that decreases the threshold for pain. The influence of cold temperatures on neuropathies has previously been reported.[19–21] Similarly, Chung et al showed aggravation of certain medical conditions such as arthritis and Raynaud's phenomenon in the winter seasons.[22]

Demonstrating an increase in DRF during the winter is not surprising and perhaps intuitive in that slip and fall injuries would be expected to be more frequent in snowy or icy, slippery conditions. Several prior studies have also noted seasonal variations in fractures. Jacobsen et al found a higher incidence of forearm fractures in the winter season in Minnesota and related this to times of freezing rain and snow.[23] In a separate study, these authors also found that the risk of hip fracture was increased on days with snow.[24] Øyen et al found

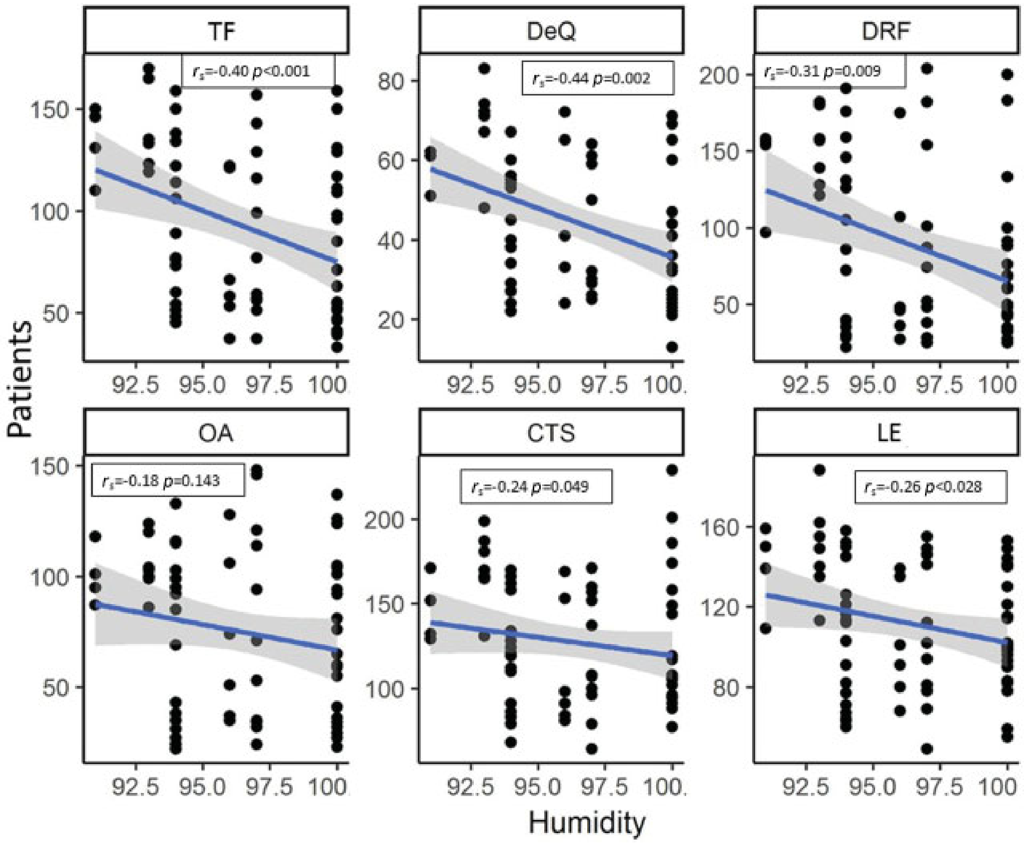

Fig. 1 Patient visits versus humidity. Gray shading indicates 95% confidence interval.

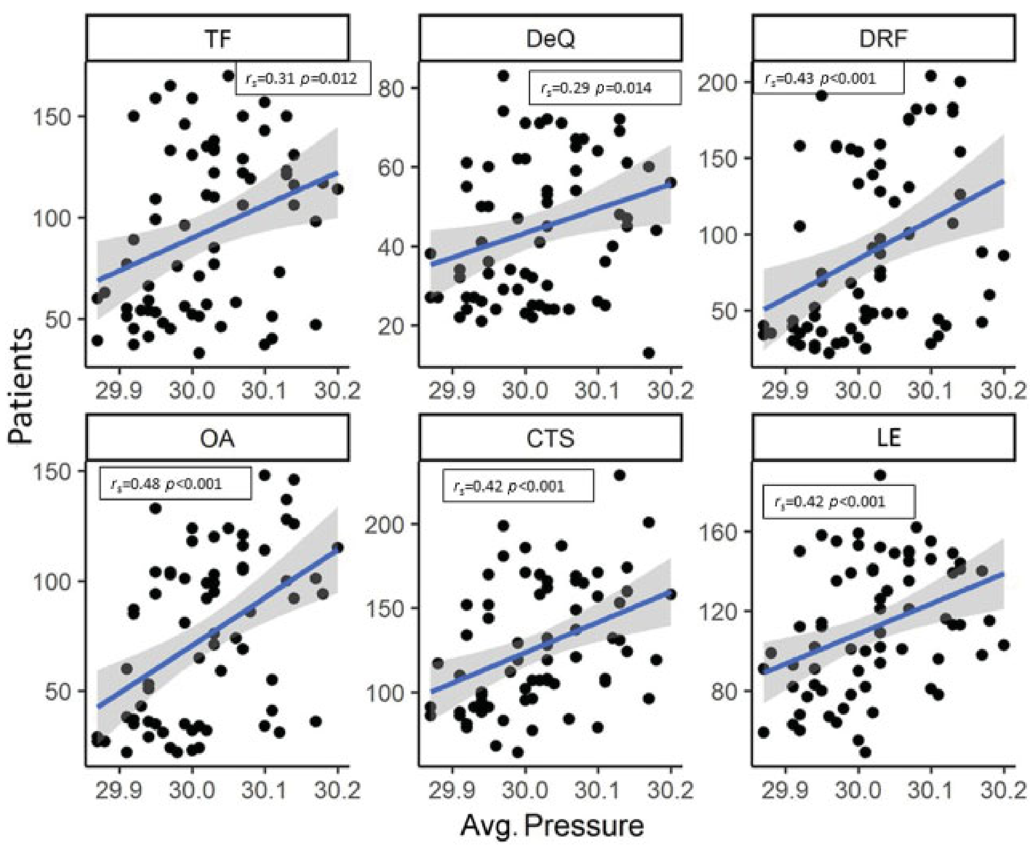

Fig. 2 Patient visits versus barometric pressure. Gray shading indicates 95% confidence interval.

that the prevalence of DRFs that occurred indoors did not vary with season but that outdoor fractures increased in the winter months.[25] Similarly, Hoff et al and Wareham et al found an increase in forearm and wrist fractures during the winter months, particularly in older patients.[26,27] Other studies, however, have contradicted these findings and found no seasonal variability in hip or upper extremity fractures.[28–30]

It is less clear how weather affects the other conditions we studied; however, environmental factors do seem to correlate with patient symptoms. We found that higher pressures resulted in increased rates and higher humidity tended to result in decreased rates of presentation for the disorders studied. Shulman et al measured the association between pain after orthopaedic trauma and changes in weather.[31] The authors found that lower barometric pressure and higher humidity were associated with increased pain at follow-up visits. There is no conclusive explanation for how pressure and humidity have an effect on pain. Several animal studies postulated that lower barometric pressure may increase sympathetic neural discharge, contributing to pain.[32–34] Other studies have shown that humidity increases inflammation and therefore pain in patients with inflammatory arthritis, which may explain increased pain in these patients.[35,36]

There are several limitations of our study. First, our data was collected based on billing codes submitted so the numbers may be inaccurate if patients presented with multiple problems or if the billing was incorrectly coded. However, this type of error is unlikely to have any effect in seasonal variation. Second, although the seasonal differences we found were statistically significant, it is unclear whether there is any clinical impact to these findings. However, in a large population such as the one we studied, or in aggregate among all patients nationwide, small percentages in differences can translate to considerable number of patients. Third, this study was performed in a specific geographic location which may not reflect patterns in other areas with different weather patterns. However, our practice is a large regional practice of 14 hand surgeons, spanning two northeastern states with office locations over an area of greater than 6500 km^2. As such, this study represents a large regional sampling. Finally, we selected only new patients for analysis. While the goal was to eliminate repeated visits for each individual patient with the same diagnosis, patients who were established to our practice and presented with one of the diagnosis under study would have been erroneously excluded.

In light of our findings, we conclude that there are seasonal and weather variations that exist within common upper extremity disorders. Although the precise mechanism by which this occurs remains elusive for most of the conditions, there does appear to be a physiologic impact of pressure and humidity. This data lays the groundwork for future work further investigating specific relationships between these pathologic states and our environment and determining the underlying pathophysiology.

Conflict of Interest
None.

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